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武夷山苔藓植物区系及其与邻近地区的关系

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摘要　本文结合地史初步探讨了第三纪以来武夷山苔藓植物可能发生的变化。武夷山的苔藓植物主要为东亚区系成分和旧热带区系成分，与泛北极区系成分的相似性也相当明显。东亚特有属（5个）系组成武夷山苔藓植物区系的重要因素之一，它低于黄山和西天目山的9个和7个，与黄山等组成一个共同的苔藓植物东亚特有属的分布中心。从各方面的分析推测，这类植物可能起源于第三纪，系一类“孑遗植物”。

关键词　苔藓植物；东亚特有属；分布中心；武夷山

武夷山横亘于福建西北部，与江西交界，地处北纬27°37′—54′，东经117°27′—51′，为我国东南沿海地区第一高峰。1955年，陈邦杰先生率队首先对武夷山的苔藓植物进行考察。1976年，上海自然博物馆也调查了该山区的苔藓植物。之后，在福建省科委和武夷山自然保护区科考站的积极支持下，作者们从1979至1984年间，连续六次深入武夷山自然保护区的各主要沟谷、山峰及不同类型的森林中进行了调查。现已知武夷山地区的苔藓植物达355种，几乎包括了从林地以至叶面附生的各种生态类型，以及丰富的苔藓植物区系成分。

有关武夷山苔藓植物的名录及其它方面的调查将另行系统报道。本文主要就武夷山与邻近地区之间苔藓植物区系的异同加以分析和探讨，希望能为武夷山的植物保护、利用和引种，提供苔藓植物方面的依据。

一、影响武夷山苔藓植物区系的地史因素

福建隶属华夏陆台（我国三大陆台之一），原为汪洋大海，一直延续至志留纪末，到泥盆纪初福建才成为陆地，后来又下陷至海平面以下，晚三迭纪又再次上升。

老第三纪末，喜马拉雅造山运动对福建古地理的影响很深，使福建的闽东、闽中两大山带重新崛起（赵昭炳，1983[1]）。在第三纪时福建地区受热带海洋性气候的影响，南部覆盖着热带常绿阔叶林带。从目前苔藓植物的分布状况估计，武夷山以至浙江南部龙泉地区的苔藓植物均在一定程度上受此影响。

第三纪末期，地球上气候变冷，波及我国大部分地区。此后，经多次冷热交替，在我国东南沿海的黄山、武夷山直至西藏东南部以及目前与亚洲大陆分离的日本，形成了较独特的苔藓植物区系成分。它们并非是亲缘关系上较接近的一类植物，而是由不同科内产生、

本文系国家自然科学基金资助项目；在野外考察期间受福建省科委、武夷山科学考察站的积极支持，并得到武夷山保护区的大力协助，谨在此表示深切谢意。

1）赵昭炳，1983：福建新生代古地理概要，福建师范大学地理系。

地理分布上近于一致的植物类型。

进入第四纪，随着喜马拉雅造山运动，武夷山也逐渐上升，山体上部的温度下降，落叶树和针叶树增加(赵昭炳，1983)。苔藓植物中的温带属、种渐向南进入武夷山。拟垂枝藓属 *Rhytidiadelphus* 和塔藓属 *Hylocomium* 等植物可能在那时开始在武夷山生长，迄今与它们通常出现的分布区及其海拔高度不一致。另一方面，一部分热带、亚热带的苔藓种类也可能在第四纪时逐步适应新的气候与环境条件，在武夷山的小环境中生存下来，也许裸蒴苔属 *Haplomitrium*、美蕨藓属 *Endotrichella* 和丝带藓属 *Floribundaria* 等属为这类植物的代表。从地史角度来看，我们目前正处于较大的间冰期，在相当长的时期内这类生境和自然条件将会继续，武夷山苔藓植物的现状也会相对稳定。

二、武夷山苔藓植物区系的基本特性

武夷山由于所处的地理位置和其它因素的影响，其苔藓植物区系具有旧热带区系成分丰富、以东亚区系成分为主的基本特点，与这两大区系的相似性系数分别为 34.1% 及 79.2%(表 1)。在我国长江流域以南地区出现的热带、亚热带大科在武夷山地区均有较高的比率，如裸蒴苔科 Haplomitriaceae (1 属、3 种)、光萼苔科 Porellaceae (2 属、8 种)、耳叶苔科 Frullaniaceae (2 属、10 种)、细鳞苔科 Lejeuneaceae (21 属、35 种)、扭叶藓科 Trachypodaceae (3 属、4 种)、蔓藓科 Meteoriaceae (10 属、17 种)、平藓科 Neckeraceae (5 属、8 种)和油藓科 Hookeriaceae (10 属、17 种)。以上 8 科总计 46 属、85 种，分别为武夷山苔藓植物属数的 24.3% 和种数的 23.9%。在东亚成分方面，大部分种类与日本有极其密切的关系，它们从武夷山的低海拔地区直至黄岗山主峰均有分布。但是，与泛北极区系成分的相似性 (26.8%) 亦是武夷山苔藓植物区系中的重要因素之一，使武夷山虽处于亚热带地区而呈现南北过渡的特点。此外，喜马拉雅山系对武夷山的影响也是存在的，其相似性系数为 14.4%，与中、南美、非洲及大洋洲的相似性系数分别为 5.0—9.2%。武夷山地区的特有种类不多，广布种也仅有 7 种。

表 1　武夷山与世界各地区苔藓植物区系之间的相似性系数

Tab. 1　The similarity coefficients between the bryoflora of Mt. Wuyi and those of the other regions in the world

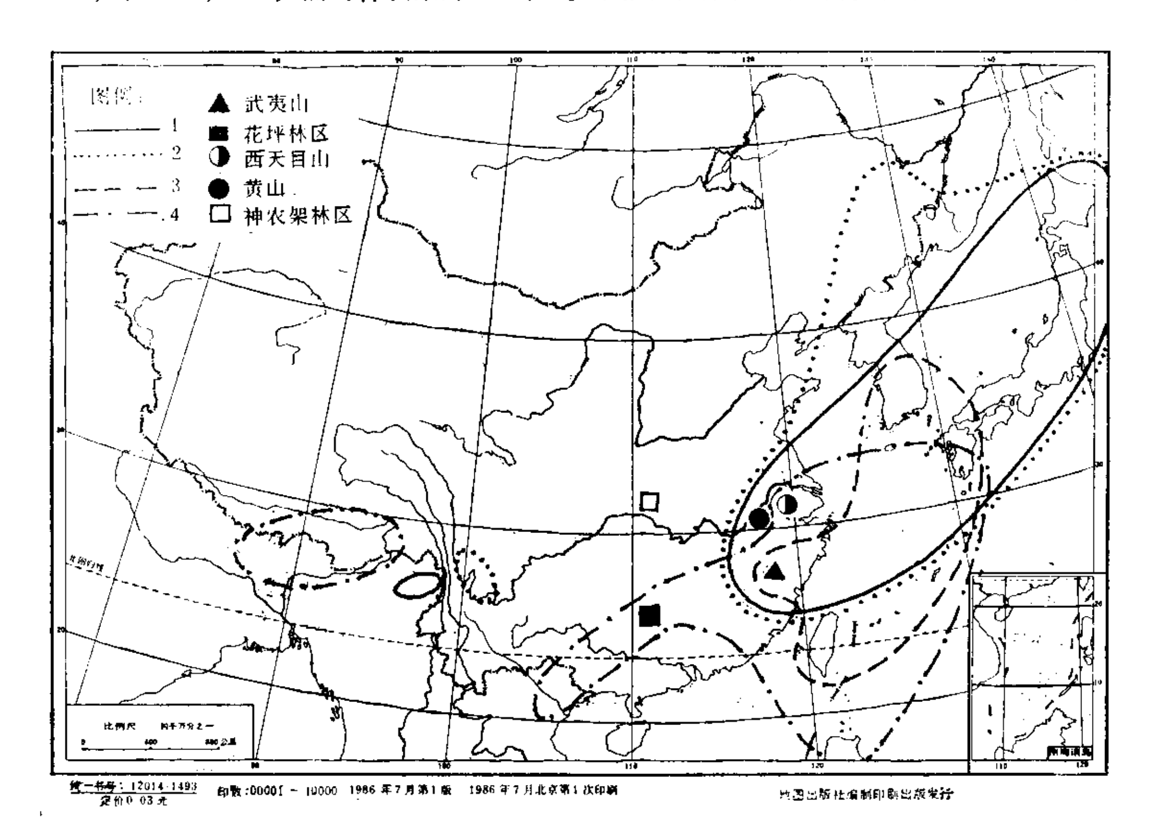
区系成分 element	我国特有 endemic to China	东亚 E. Asia	东喜马拉雅 E. Himalaya	东南亚 SE. Asia	泛北极 Holarctic	中南美 C. & S. America	非洲 Africa	大洋洲 Oceania	世界广布 Cosmopolitan
相同种数 number of common species	16	281	51	121	95	18	29	33	7
相似性系数 similarity coefficient	4.5	79.2	14.4	34.1	26.8	5.0	8.1	9.2	1.9

1958 年，陈邦杰把武夷山划为我国苔藓植物的“南北区系交汇区域”的“华中区”内，并认为该地区“尤富于东亚特有的苔藓植物种属”，但武夷山区的东坡被归入“岭南区”[3,5,6]。近年来，一些新发现的事实进一步证实了武夷山苔藓植物所具有的特点。最引

人注目的事实有二方面：其一，武夷山苔藓植物区系中东亚成分占绝对优势，但主要体现在种的水平上，东亚特有属的比率却较低，目前所知为5个，然而，我国东南沿海山区中海拔低于武夷山的黄山已发现9个东亚特有属，甚至位于华中的湖北神农架亦有4个东亚特有属；其二，武夷山所发现的叶附生苔类植物有7科、21属和36种，均仅次于海南岛和西双版纳[7]，所不同的是前两者均处于我国仅有的热带雨林地区，而武夷山的叶附生苔类多着生在亚热带沟谷常绿阔叶林内，也见于一些山坡常绿阔叶林叶面。叶附生苔类植物在武夷山地区大量分布似与该地区所处的地理位置并不一致。

三、与我国邻近地区苔藓植物区系的关系

我国地域辽阔，各地区的苔藓植物区系成分差别较大，这里主要将武夷山的苔藓植物与邻近、隶属陈邦杰所划分的华中区的作对照分析。广西花坪林区属岭南区，但其纬度及山体高度与武夷山甚接近，因此也将予以对比(图1)[12]。据粗略的统计，武夷山的藓类植物在属相似性系数方面，与广西花坪林区为56.3%，与浙江南部龙泉和安徽黄山分别为62.7%和51.6%[9,11]，而与神农架为46.8%[1)]。武夷山与其它山区藓类植物的科和种之间



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图 1 囊绒苔属(1)、多瓣苔属(2)、拟金毛藓属(3)和拟木毛藓属(4)植物的分布图。
Fig. 1 The distribution of *Trichocoleopsis* (1), *Macvicaria* (2), *Myuriopsis* (3) and *Pseudospiridentopsis* (4).

1) Wu, P. C., M. R. Crosby et R. E. Magill, 1986: A Floristic and Phytogeography Survey of the Bryophytes on Mt. Shennongjia, Western Hubei, China. Ann. Missouri Bot. Gard. (in press)

相似性系数见表 2。广西花坪尚有待深入工作[12]。因此，武夷山藓类的属和种与浙南地区的相似性系数远高于其它山区，神农架的最低。在苔类方面，武夷山和花坪均发现裸蒴苔属 *Haplomitrium* 和紫叶苔属 *Pleurozia* 很使人感兴趣，这两属在浙南、黄山和神农架地区均无任何记录[4,11]。武夷山藓类中最大的、主要分布热带、亚热带的蔓藓科 Meteoria-

表 2 武夷山与其邻近地区之间藓类植物区系的相似性系数

Tab. 2 The similarity coefficients between the mossflora of Mt. Wuyi and those of its neighbouring mountain regions in China

地区 locality / 共有数和相似性系数 number of common taxa, similarity coefficients	广西花坪 Huaping, Guangxi	浙江 Zhejiang	安徽黄山 Mt.Hwangshan, Anhui	湖北神农架 Mt. Shennongjia, Hubei
科 families	31 (75.6)	31 (75.6)	33 (80.5)	31 (77.5)
属 genera	71 (56.3)	79 (62.7)	65 (51.6)	59 (46.8)
种 species	72 (33.8)	80 (37.6)	65 (30.5)	46 (21.6)

表 3 蔓藓科各属在武夷山及其邻近地区的分布*

Tab. 3 The distribution of the genera of Meteoriaceae in Mt. Wuyi and its neighbouring regions in China

地区 region / 种数 species number / 属名 genus name	福建武夷山 Mt. Wuyi, Fujian	广西花坪 Huaping, Guangxi	浙江 Zhejiang	安徽黄山 Mt. Hwangshan, Anhui	湖北神农架 Mt. Shennongjia, Hubei
Aerobryopsis	2	2	2	1	2
Aerobryidium	—	—	1	—	—
Aerobryum	1	1	1	—	—
Barbella	2	1	2	2	2
Barbellopsis	—	1	—	—	—
Chrysocladium	1	1	2	1	1
Floribundaria	2	3	1	—	1
Meteoriopsis	1	—	1	1	3
Meteorium	2	2	4	4	5
Neobarbella	1	1	—	—	—
Papillaria	2	1	—	—	—
Pseudobarbella	3	3	1	1	—
属数 total number of genera	10	10	9	6	6
种数 total number of species	17	16	15	10	14

* 参阅吴鹏程，1960：浙江藓类植物名录。
吴鹏程、林尤兴，1965：广西花坪林区苔藓植物名录。
Wu P. C., M. R. Crosby et R. E. Magill, 1986: A Floristic and Phytogeography Survey of the Bryophytes on Mt. Shennongjia, Western Hubei, China. Ann. Missouri Bot. Gard. (in press).

ceae 的属和种与其它山区的相似性，亦明显体现其苔藓植物区系关系中所处的地理位置的影响(表 3)。

然而，花坪林区显然由于地理纬度稍偏南，分布于其中的部分热带、亚热带属如油藓科的拟油藓属 *Hookeriopsis* 和刺果藓属 *Symphyodon* 及蕨藓科的蕨藓属 *Pteorbryum* 等未见分布武夷山。浙江龙泉山区的八齿藓属 *Octoblepharum* 和拟平藓属 *Neckeropsis* 亦均未在武夷山发现。黄山则开始出现武夷山未有分布的温带属拟附干藓属 *Schwetschkeopsis* 和福氏藓属 *Fauriella* 等[4]。神农架所处位置不仅偏北且又在武夷山西侧，为大巴山的余脉，海拔达 3000m，较武夷山的主峰黄岗山还高出约 1000m，因此不少温带属如角齿藓属 *Ceratodon*、皱蒴藓属 *Aulacomnium*、小鼠尾藓属 *Myurella*、毛羽藓属 *Bryonoguchia* 及山羽藓属 *Abietinella* 等生长极为良好，呈现了另一种景色，这与武夷山的苔藓植物区系成分是显然不同的。

通过武夷山苔藓植物区系与邻近地区苔藓植物区系的比较，表明武夷山显示了处于中亚热带而地理位置略偏南的特性，东亚区系成分为武夷山苔藓植物区系中的主要因素，但具明显的热带、亚热带特性，并包含部分不起主导作用的温带成分。

四、武夷山苔藓植物区系中的东亚特有属

在武夷山苔藓植物的区系成分中，我国苔藓植物区系的一个独特的因素——东亚特有属是不可忽视的(表 4)[1,6,8]。东亚特有属在武夷山并不占很高的比例 (3.1%)，并低于

表 4 东亚特有属在武夷山及其邻近地区的记录

Tab. 4 The records of the east asiatic endemic genera in Mt. Wuyi and its neighbouring regions in China

福建武夷山 Mt. Wuyi, Fujian	浙江 (包括西天目山) Zhejiang, including Mt. West Tianmu	安徽黄山 Mt. Hwangshan, Anhui	湖北神农架 Mt. Shennongjia, Hubei
Trichocoleopsis	*Trichocoleopsis*	*Trichocoleopsis*	——
——	——	*Neotrichocolea*	——
Macvicaria	——	*Macvicaria*	——
Myuriopsis	——	——	——
Pseudospiridentopsis	*Pseudospiridentopsis*	——	——
Meteoriella	*Meteoriella*	*Meteoriella*	——
——	*Dolichomitra*	*Dolichomitra*	——
——	*Dolichomitriopsis*	*Dolichomitriopsis*	——
——	*Miyabea*	*Miyabea*	*Miyabea*
——	——	——	*Bryonoguchia*
——	*Eurohypnum*	*Eurohypnum*	*Eurohypnum*
——	*Okamuraea*	*Okamuraea*	*Okamuraea*

地理位置相差不远的黄山和西天目山。现知武夷山 5 个东亚特有属中，苔类为囊绒苔属 *Trichocoleopsis* 和多瓣苔属 *Macvicaria*，藓类有拟金毛藓属 *Myuriopsis*、小蔓藓属 *Meteoriella* 及拟木毛藓属 *Pseudospiridentopsis* (图 2)。除拟金毛藓属仅与台湾共有外[15]，其它属与黄山或西天目山有共同分布，或仅在一个山区有分布[4,11]。这些为数不多的东亚特有属对一个山区的苔藓植物区系似并不重要，但如果考虑到我国苔藓植物仅有为数约 30 个

东亚特有属，武夷山作为一个山区发现 5 个东亚特有属，即意味着近乎 1/6 东亚特有属的分布，其影响显然不能以数量来估计。现知黄山与西天目山分别有 9 个及 7 个东亚特有属。湖北神农架有 4 个，但广西花坪林区目前仅知 2 个东亚特有属的记录，然而，在武夷山南面的广东鼎湖山尚未发现任何东亚特有苔藓植物属[10,12]。

所谓东亚特有苔藓植物属，系指属内种的分布范围主要局限于中国、日本和朝鲜，包括喜马拉雅东部，很少见于南亚局部地区和苏联西伯利亚[6,8,14]的属，因此，这些属基本上习生于较为温暖湿润的环境，它们均为单种属或少种属。武夷山所发现的 5 个东亚特有属中均为单种属（其中拟金毛藓属和拟木毛藓属各包括 1 变种）。在这些属中也存在间断分布现象。现我国台湾分布的 6 个东亚特有属中的 5 个与武夷山相一致；而日本发现的约 11 个东亚特有属全与我国共同分布，占我国已知该类植物的 1/3 左右。表明了它们之间在植物地理关系方面存在相当长的历史，而我国台湾及日本分布的东亚特有苔藓植物属多半是在这些岛屿与亚洲大陆分离之前就已存在。探索其分布与分布中心目前尚缺乏直接的化石依据，但推测这些属至少产生于第三纪末期可能是符合地史因素的。现有的东亚特有属的间断分布现象意味着这些属在一定环境影响下部分分布区已趋缩小，种类也随之而减少[6]，第四纪以来冰期和气候的变迁可能是最主要的原因，喜马拉雅山系的上升也使它们产生分化或进一步的特化。从这些因素予以考虑，我们认为苔藓植物中的东亚特有属可能系一类“第三纪孑遗植物”。

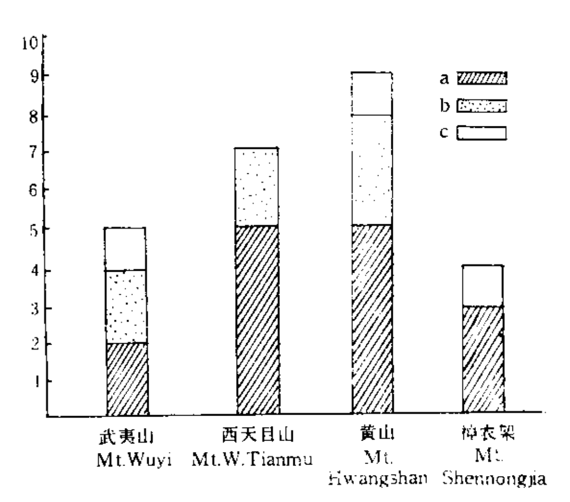


图 2　武夷山及其邻近地区的东亚特有苔藓植物属的比较
a. 出现于三个或三个以上山区的属数。 b. 出现于二个山区的属数。c. 只出现于一个山区的属数。

Fig. 2　The comparison of the similarity of genera endemic to East Asia between Mt. Wuyi and its neighbouring regions in China.
a. number of genera occurring in three or more than three mountain regions. b. number of genera occuring in two mountain regions. c. number of genera occuring only in one mountain region.
Mt. Wuyi (27°37′—27°54′N, 117°27′—117°51′E)
Mt. W. Tianmu (30°22′N, 119°27′E)
Mt. Hwangshan (30°10′N, 118°11′E)
Mt. Shennongjia (31°42′N, 110°35′E)

一个尚无法解释的问题是，黄山、西天目山以及神农架等均被认为曾受过冰川直接的影响（虽然迄今学者们对此看法并不一致），而武夷山则被认为从未发生过任何冰川[13]，仅经受过气温变迁的影响1)。现有材料却表明，武夷山的苔藓植物区系与黄山、西天目山苔藓植物区系之间存在密切的关系，而它们在东亚特有属之间亦较为相似。在这三个山区分布的东亚特有苔藓植物属中，有 40—70% 的属相同，其余约 30—40% 的属在二个山区同时出现（图 2）。武夷山的一个东亚特有属拟金毛藓属 *Myuriopsis* 仅见于我国台湾、日本及朝鲜[14,15]。另一个中国特有属新船叶藓属 *Neodolichomitra* 系与台湾共同分布，显示

1) 赵昭炳，1983：福建新生代古地理概要。福建师范大学地理系。

了武夷山与黄山、西天目山之间还存在一定的差异。现有资料表明,黄山多岩石的特点或许与部分东亚特有苔藓植物属的分布有一定的关系。东亚特有苔藓植物属的数目在武夷山趋于减少,因此该地区可能系处于以黄山为中心的我国东部苔藓植物东亚特有属分布中心的边缘。而神农架的 3/4 的东亚特有苔藓植物属虽然与黄山和西天目山有共同的分布,但考虑到神农架的整个苔藓植物区系中,温带属的成分增加较显著,估计它可能与四川东南部的一些山区归属另一个苔藓植物的分布中心。

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RELATIONSHIPS BETWEEN THE BRYOFLORA OF MT. WUYI, SE CHINA, AND THOSE OF NEIGHBOURING MOUNTAIN REGIONS*

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Abstract Mt. Wuyi, located at 27°37′—27°54′ N, 117°27′—117°51′ E, is the highest mountain in South-East China. Its main peak, Huanggangshan, is 2158 m above the sea level. In 1955, P. C. Chen organized the first expedition to Mt. Wuyi, and the authors investigated the different ravines and the forests of that area in 1976 and from 1979 to 1984 respectively. Up to now 355 species of the bryophytes have been found in Mt. Wuyi.

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1. The influence of the factors of geological history on the bryoflora of Mt. Wuyi

Fujian Province, belonging to Cathaysian, one of three Chinese ancient lands, was a part of ocean until the end of the lower Tertiary. In the early Devonian, Fujian uplifted above the sea level, but it submerged in the sea later, and then uplifted above the sea level again in the upper Triassic.

By the end of the lower Triassic the Himalayan movement influenced the paleogeography of China deeply, and the eastern and central mountains of Fujian uplifted again. In the Tertiary, Fujian was influenced by the hot maritime weather, so the tropical evergreen forests existed in southern Fujian at that time. The conclusion was made by Z. B. Zhao in 1983 after his long period of study on geological history of Fujian Province since the Yanshan movement.

According to the morden geographical distribution of Chinese bryophytes, it seems that the above influence might be related to the bryophytes of Mt. Wuyi and also the southern part of Zhejian Province. By the end of the Tertiary the weather became cold in most parts of China. Since then the cold weather and hot weather alternated several times. One kind of the endemic elements of the bryoflora formed in the area from the south-eastern coast of China to the southeastern Xizang (Tibet), including Japan. They are not specialized at the family level or closely related to each other, but they have similar distribution and belong to different families.

In the Quaternary, Mt. Wuyi gradually uplifted following the Himalayan movement. As the weather cooled down in the upper part of the mountain, deciduous broad-leaved and needle-leaved trees increased there. Meanwhile, temperate genera and species of the bryophytes spread and invaded South China and entered Mt. Wuyi. *Rhytidiadelphus* and *Hylocomium* probably began to grow in Mt. Wuyi at that time, and their distribution is quite different from their primary one. On the other hand, a part of tropical and subtropical bryophytes might enjoy the changed weather and environment in the Quaternary and existed in a few small localities of Mt. Wuyi, and the genera *Haplomitrium, Endotrichella* and *Floribundaria* are probably their representatives. From the point of view of geological history we are now living in the interglacial period and the present natural conditions will last continuously, so they will steadily influence the bryoflora of Mt. Wuyi in a long period of time.

2. Essential characteristics of the bryoflora in Mt. Wuyi

Due to the geographical position and the other factors of Mt. Wuyi the bryoflora is represented by numerous tropical and subtropical elements (34.1%), but the East-Asiatic endemic ones (79.2%) are characteristic of the bryoflora in Mt. Wuyi (Tab. 1). The tropical and subtropical families of the bryophytes, found south of Changjiang (Yangtzi) River, are Haplomitriaceae (1 genus, 3 species), Porellaceae (2 genera, 8 species), Frullaniaceae (2 genera, 10 species), Lejeuneaceae (21 genera, 35 species), Trachypodaceae (3 genera, 4 species), Meteoriaceae (10 genera, 17 species), Neckeraceae (5 genera, 8 species) and Hookeriaceae (3 genera, 3 species). The above 8 families, including 46 genera and 85 species, represent about 1/4 genera (24.3%) and less than 1/4 species (23.9%) of the bryoflora of Mt. Wuyi.

Most species of East-Asiatic elements show very close relationships with Japan, and are widely distributed from the low altitude of Mt. Wuyi to the summit of Mt. Huanggangshan. However, the Holarctic species (26.8%) are also important elements of the bryoflora in Mt. Wuyi, showing its transition nature, although it is located in the subtropics. Moreover, the influence of the Himalayas also exists in Mt. Wuyi, and the Himalayan elements cover 14.4% in the bryoflora of Mt. Wuyi. The similarity coefficients between the bryofloras of Central and South America, Africa and Oceania and that of Mt. Wuyi are from 5.0—9.2% respectively. The

endemic species are not very many and cosmopolitan species are only 7 there.

In 1958, P. C. Chen designated Mt. Wuyi as "the transition region of South and North China rich in East-Asiatic genera and species". His very important conclusion is essentially in accordance with the fact of the bryoflora on Mt. Wuyi. Recently, some of the new records further show the characteristics of the bryoflora in Wuyi. Two facts are worth being mentioned. One is that East-Asiatic genera are only five in Mt. Wuyi. However, there are 9 East-Asiatic genera in Mt. Huangshan more than in Mt. Wuyi; 4 East-Asiatic genera are recorded in Mt. Shennongjia. The other is that epiphyllous liverworts in Mt. Wuyi, consisting of 7 families, 21 genera and 36 species, are less than on Hainan Island and Xishuangbannan, located in the tropics in China.

3. Comparison between the bryoflora of Mt. Wuyi and those of the neighbouring regions

As China covers a very large area, bryofloristic elements are quite different in the different regions. In this section, we are concentrated on making a comparison between the bryofloras of Mt. Wuyi and the regions belonging to the Central China of the bryoflora named by P. C. Chen.

Huaping Forest Region, Guangxi Zhuang Autonomous Region in South China, with both latitute and altitude very similar to Mt. Wuyi, is included in this comparison (Fig. 1). According to the rough estimation, the similarity coefficient of moss genera between Mt. Wuyi and Huaping is 56.3%, and those between the mountain and southern Zhejian and Mt. Huangshan, Anhui, are 62.7% and 51.6% respectively, while the similarity coefficient of the genera of the mossfloras between Mt. Shennongjia and Mt. Wuyi is 46.8%. Table 2 shows the statistics of mosses in Mt. Wuyi and the others, but the bryoflora of Huaping needs further study. However, it is very interesting to note that *Haplomitrium* and *Pleurozia* of liverworts are both found in Mt. Wuyi and Huaping Forest Region, and the similarity coefficient between the mossfloras of Mt. Wuyi and Zhejian Province is also higher than those mentioned above.

Tropical and subtropical elements reduce towards the north in China, and temperate ones increase. Huaping is located in the south, and, as expected, some tropical and subtropical genera such as *Hookeriopsis* and *Symphyodon* have been found there, but not in Mt. Wuyi; several temperate genera, such as *Schwetschkeopsis* and *Fauriella,* have been recorded in Mt. Huangshan, but not in Mt. Wuyi. For some unknown reasons, *Octoblepharum* and *Neckeropsis* are only found in southern Zhejiang, but not in Mt. Wuyi. Mt. Shennongjia, with its main peak over 1000 m higher than that of Mt. Wuyi, is located in its northwest, and more than ten temperate genera, such as, *Ceratodon, Aulacomnium Myurella, Bryonoguchia* and *Abietinella* have been found there.

Generally, Mt. Wuyi belongs to the central subtropical region of China, and East-Asiatic endemic genera are the main elements of its bryoflora, but the bryoflora also consists of tropical and subtropical elements with some temperate ones.

4. East-Asiatic endemic genera in the bryoflora of Mt. Wuyi

In the bryoflora of Mt. Wuyi, one of the main elements, East-Asiatic endemic genera, should not be neglected (Tab. 4). East-Asiatic endemic genera in Mt. Wuyi (five) are less than in Mt. Huangshan and Mt. West Tianmu, although the positions of the latter two are very close to Mt. Wuyi. East-Asiatic endemic genera of liverworts are *Trichocolea* and *Macvicaria* so far found in Mt. Wuyi, and the mosses are *Myuriopsis, Meteoriella, Pseudospiridentopsis* (Fig. 1). *Myuriopsis* is only distributed in Taiwan Province and Mt. Wuyi, and the other four are distributed in Mt. Huangshan or Mt. West Tianmu, and also in Taiwan, besides in Mt. Wuyi. About thirty East-

Asiatic endemic genera have so far been known in China, which means that about one sixth of East- Asiatic endemic genera of the bryophytes occur in Mt. Wuyi. We may notice that nine and seven East-Asiatic endemic genera of the bryophytes have been recorded in Mt. Huangshan and Mt. West Tianmu respectively. In Mt. Shennongjia, Central China, there are four East-Asiatic endemic genera, but only two have been found in the Huaping Forest Region, South China. In Mt. Dinghua, located south of Mt. Wuyi, on East-Asiatic endemic genus of the bryophytes has so far been found.

East-Asiatic endemic genera of the bryophytes are mainly limited to China, Korea and Japan, including the East Himalayas, rarely occur in South Asia, Siberia of the Soviet Union. Therefore, these genera enjoy a warm and moist environment. In Mt. Wuyi, all the East-Asiatic endemic genera are monotypic ones with a disjunct distribution. Now in Taiwan Province five of six recorded East-Asiatic endemic genera are common to Mt. Wuyi. In Japan, about eleven, i.e. one third of, East Asiatic endemic genera so far found are common to China, which shows a long history of the phytogeographical relationships between Japan and China. East Asiatic endemic genera of the bryophytes might therefore exist on islands of Taiwan Province and Japan before they were separated from the mainland of Asia. However the fossil evidence is still lacking in the bryophytes, so we are not able to discuss about the distribution area and the distribution center of the East-Asiatic bryoflora in detail. The above estimation is more or less related to geological history, and we assume that the East-Asiatic endemic genera have existed at least since the end of the Tertiary. Starting from the Quaternary, the climatic change during glacial epoch has been possibly the most important factor affecting the bryoflora in Asia, and the upheaval of the Himalayas has stimulated the diversity and the specialization of the bryophytes. Considering these factors, East-Asiatic endemic genera might be the "Tertiary fossil plants".

Another problem is difficult to explain, because Mts. Huangshan, West Tianmu and Shennongjia were once influenced by glaciation directly, although Chinese geologists hold different views. However, no evidence of glaciation has been found in Mt. Wuyi. It is worth to study the close relationships between Mt. Wuyi, Mt. Huangshan and Mt. West Tianmu, where is the distribution center of the East-Asiatic endemic genera. The above three mountain regions share half of the East-Asiatic endemic genera, and about 32% genera of the others are found in two of them (Fig. 2). *Myuriopsis*, one of the East Asiatic types, was only recorded in Taiwan Province, Japan and Korea. *Neodolichomitra*, occuring in Taiwan Province, is endemic to China. More or less the differentiation has taken place in Mt. Huangshan, Mt. West Tianmu and Mt. Wuyi. The number of the East-Asiatic endemic genera is smaller in Mt. Wuyi, so it is possibly located on the border of the distributional center of the East-Asiatic endemic genera. Moreover, three of four East-Asiatic endemic genera in Mt. Shennongjia are also found in Mt. Huangshan and Mt. West Tianmu, but the other East-Asiatic genus in Mt. Wuyi is common to the mountain areas in SW China, the Qinglin Range of NW China, and the isolated mountain areas of NE China. Considering all the characteristics of the bryoflora of Mt. Shennongjia, we assume that Mt. Shennongjia may belong to another distribution center, including SW part of Sichuan Province, and the other neighbouring mountains.

Key words bryoflora; East-Asiatic endemic genera; distribution center; Mt. Wuyi, SE China